being to show, that the recent application of rifling to cannon is especially advantageous for increasing the size and power of guns made upon the principle proposed by him in the former memoir.

Professor W. B. Rogers exhibited a new form of electrophorus, made of vulcanite, by Mr. Cornelius of Philadelphia, which has the advantage of working perfectly in damp as well as in dry weather. He also showed an adaptation of the same apparatus in another form, for the lighting of gas-lamps.

Professor B. Peirce discoursed on the mathematical properties of the elastic sac, which he thought had some bearing upon physiological problems.

Five hundred and twenty-second Meeting.

May 26, 1863. — ANNUAL MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary, on the part of the Council, read the following Report: —

Upon a revision by the Council of the roll of the Academy, it appears that six Fellows, two Associate Fellows, and two Foreign Honorary Members have been elected into this Society during the past year.

On the Foreign list, Christopher Hansteen was chosen to fill the vacancy left by the death of the venerable Biot, in the First Class and Leopold von Ranke, in place of the late Sir Francis Palgrave, in the Third Class.

The two Associate Fellows, Professor Newton and General Humphreys, are both of the First Class.

Of the six resident Fellows, four were assigned to the First Class, one to the Second, and one to the Third Class.

Nine of our members, — the same number as last year, — viz. two Foreign Honorary Members, four Associate, and three Resident Fellows, have deceased during the year, or at least since the last Annual Report was drawn up.

One of the Resident Fellows, JAMES FOWLE BALDWIN, of the section of Technology and Engineering, died suddenly, on the 20th of May, 1862, a week before our anniversary meeting.

Mr. Baldwin was born in Woburn, at the little village of New Bridge, on the 29th of April, 1782. His father, Colonel Loammi Baldwin, was a cabinet-maker and a land-surveyor. The latter occupation, more congenial to his taste, led him to the projection of plans for the internal improvement of his native county. He devised and carried to successful completion the Middlesex Canal, one of the earliest, and for the time one of the most considerable works of the kind in the United States. He was a native of the same village with Count Rumford, was his constant friend through his political trials, and under his care and that of his son Rumford's daughter, the Countess Rumford, passed the greater part of her life. James, the fourth son of Colonel Baldwin, received the usual instruction of the village school of his native town, and afterwards went to the academies in Billerica and Westford. About the year 1800 he was in Boston preparing for a mercantile life, and after a few years was established as a merchant. But the influence of his early associations with his father, and the example of his brother Loammi, who, though educated as a lawyer, had relinquished this profession for that of an engineer, stimulated his own turn for the same pursuit. When Loammi was engaged in the construction of that beautiful and massive work, the Dry-Dock at the Charlestown Navy Yard, the first of its kind in this country, James joined him, and thus commenced in earnest the work of his life.

In the year 1828, a railroad from Boston to Albany was projected, and Mr. Baldwin was one of the commission appointed by the State to make the surveys. Upon this arduous work he was employed for two years. Although the enterprise was not proceeded with at that time, yet subsequently the Western Railroad, now in operation, was built upon the location selected by him, and his plans for its construction were generally adopted. Mr. Baldwin looked upon this, next to the supply of pure water to the city of Boston, as the most important of his professional works. From 1830 to 1835, he was employed in the construction of the Boston and Lowell Railroad, and in the planning of several of the mills of manufacturing companies in this and the neighboring States. He also determined the relative amount of water-power used by the mills of the different companies at Lowell.

In 1825, the subject of supplying Boston with pure water began to attract serious attention. Different sources were investigated, and estimates made. In 1837, Mr. Baldwin was appointed on a commission still further to inquire into and recommend a plan for this object. A majority of this commission recommended the introduction of water from Spot and Mystic Ponds, — from the latter by pumping. From these sources they proposed to furnish three millions of gallons daily, a sufficient supply, as they supposed, for ten years. Mr. Baldwin dissented, and recommended Long Pond (Lake Cochituate), which would itself furnish nine millions of gallons daily, and could be materially increased from other sources in the same water-shed. He urged the adoption of a conduit of masonry instead of iron pipe, and of gravitation instead of pumping. The city authorities adopted the plan of the majority; it was submitted to a popular vote, and rejected. The project was not revived until the year 1844, when Mr. Baldwin was again on the commission. The plan proposed by him was adopted at the close of March, 1846, and the work was completed on the 25th of October, 1848. Instead of three millions of gallons daily for the first ten years, it actually delivered fifteen millions of gallons during that period. It may fairly be claimed that the city of Boston is pre-eminently indebted to the forecast, firmness, and professional skill of Mr. Baldwin for its present abundant and constant supply of pure water from Cochituate.

Although confining himself to his professional duties, and having little taste for politics, Mr. Baldwin was once elected a Senator for Suffolk, and he held the office until his appointment as Water Commissioner.

Mr. Baldwin was of commanding presence, being considerably above six feet in stature, and remarkably well-proportioned. He was dignified and affable in manners, kind and benevolent in disposition, warm and unfaltering in his friendships. Steadfast in his conviction of the right, no force could drive nor influence allure him from the path of duty. His mind was clear, but not rapid in its operations. He came to his conclusions by successive steps, carefully taken, and closely examined; but the results once reached, his confidence in them was rarely shaken. His judgment was formed upon a wide consideration of all the circumstances, rather than upon nicely balanced computations. He was more anxious that his works should abound in strength, than that they should be constructed with the least theoretical amount of material and the greatest possible economy.

NATHAN HALE, another of the oldest members of the same section, having been a Fellow of the Academy for forty-four years, died on the 8th of February of the current year.

He was born in Westhampton, Massachusetts, on the 16th of August, 1784, was graduated at Williams College in 1784, studied law at Troy, New York, was a teacher of mathematics at Phillips Academy, Exeter, New Hampshire, and settled in Boston in 1810, where he soon became a member of the Suffolk bar. On the first of March, 1814, he became the editor of the Boston Daily Advertiser, the earliest daily paper in this city; and he retained his connection with it for more than forty years. He was the first to introduce an editorial department as an essential part of a public journal; and by the justice, thoroughness, and sagacious prudence with which he managed this department, by the fairness of his criticisms, and by the discrimination and pure taste of his selections, he not only secured the confidence of the community, but did much to elevate the character of journalism. A journal more entirely reliable than Mr. Hale's was not to be found. Those who have regularly read what has appeared in its columns have seldom missed any event of public importance which has occurred in either hemisphere; and any one who should now wish to get a clear, condensed, honest, and unprejudiced view of the civil, social, and literary history of the last half-century would be rewarded for the labor of examining the columns of the Daily Advertiser. Although his unceasing duties as editor, and in the public and private offices he filled, left little time for original investigation, and he may have done nothing for the advancement of science directly, he did what was not less honorable nor less deserving of respectful remembrance, by constantly availing himself of the resources of science, with which he kept himself familiar, for the advancement of the useful arts. He was the first in this State to apply the power-press to newspaper printing. He made from original sources a valuable map of New England, and an excellent manual of geography, illustrated by maps printed with common types. More than all, he took a leading part in the establishment of the railway system in New England, and in the introduction of pure water into Boston. Associated as he was, in these important works, with men of greater knowledge and skill as engineers, and more full of original suggestions, he still did as much as any one else to advance these objects, by his perseverance and devotion, by the enlarged views he was

constantly presenting in his journal, by his able advocacy of them, in both houses of the Legislature, and by the confidence reposed in his prudence, his extensive knowledge, his calm judgment, and his spotless integrity. Although, from his scrupulous delicacy, he derived no pecuniary advantage from his severe and long-continued labors in these works for the public good, and died poor, he had the pure satisfaction, in his last years, of having contributed at least as largely as any one individual to the health and welfare of his adopted city, and to the unexampled prosperity of his native State.

As a writer, Mr. Hale commanded attention and secured confidence by the purity of his style, by the clearness and exactness of his statements, by the fulness of his knowledge, and by his entire sincerity. He was always interested in the advancement of literature, and was one of the founders of the North American Review and of the Christian Examiner. He was for many years an active member of the Massachusetts Historical Society. He was a member both of the Convention of 1820, and of that of 1853, for the amendment of the Constitution of this Commonwealth.

Benjamin D. Greene, whom we have lost from our botanical section, died on the 14th of October last. He was born in Demarara, during the temporary sojourn of his parents there, in the year 1793, and was graduated at Harvard College in 1812. He first pursued legal studies, for a time in the then celebrated law-school at Litchfield, Connecticut, and was duly admitted to the bar in Boston. He then studied medicine, mainly in the schools of Paris and Scotland, and took the degree of M. D. at Edinburgh in the year 1821. While pursuing these studies abroad, his scientific tastes were strongly developed, especially for Botany, which, on his return home to the enjoyment of an ample fortune, now became the favorite pursuit of his life. His retiring, contemplative, and unambitious disposition rendered him averse to the toils, and wholly indifferent to the fame, of authorship. Of him it may especially be said, that he pursued his scientific studies for the pure gratification which they afforded him; but those who knew him are well aware that no small part of that gratification came from the pleasure which he took in freely placing his observations and his collections in the hands of those who could turn them to best account for the advancement of science. Perceiving that the great obstacles encountered by the naturalist here were the want of books, and of authentic collections, he early and steadily endeavored to sup-

ply these desiderata, so far as he could, in one department, by gathering a choice botanical library, and a valuable herbarium, especially rich in authenticated specimens and in standard North American collections. These were most kindly placed at the disposal of working botanists, even those of distant parts of the country; and, to secure their continued usefulness, were at length, by gift and by bequest, consigned to the Boston Society of Natural History, — of which Mr. Greene was one of the founders, and the first President, — to which, besides, he bequeathed a large legacy in money.

In character, Mr. Greene was remarkably quiet and unobtrusive, yet highly sensible, cultivated, and discriminating. Eminently kind and disinterested, if he gave no thought to secure for himself a scientific reputation, he should all the more be remembered for the wise and considerate liberality through which he sought to promote the investigations of others in a chosen department of natural history.

Of the four Associate Fellows deceased, one of the most distinguished, Ormsby McKnight Mitchel, was born on the 28th of August, 1810, in Union County, Kentucky. With a scanty early education, and still more scanty material wealth, he entered the Military Academy at West Point in 1825, where he was graduated in 1829 with a class-rank of fifteenth, and where for the next two years he was Assistant Professor of Mathematics. Having resigned his commission as Second Lieutenant of Artillery, which bears the date of July 1, 1829, he studied law in Cincinnati. But he soon left the practice of it for a professorship of Mathematics and Astronomy in Cincinnati College, which he held from 1834 to 1844. By his zeal and eloquence, an enthusiasm for astronomy was created in the West, which resulted in the establishment of the Cincinnati Observatory, with its admirable equatorial telescope; the corner-stone being laid in November, 1843, in the presence of the venerable Ex-President John Quincy Adams. In July, 1846, Professor Mitchel began the issue of the "Sidereal Messenger," and he continued its publication for two years, to the benefit of popular science. He also published a work on "Popular Astronomy," and another on "The Planetary and Stellar Worlds." At his chosen observatory he applied himself to the study of the double stars in southern declination, and discovered the companion of Antares. He also measured the time of rotation of Mars. Professor Mitchel was one of the first to recognize the value of the electric method of observing Right Ascensions and Declinations, and he

devised an instrument for that purpose, which attracted the favorable attention of astronomers, and was largely discussed at meetings of the American Association for the Advancement of Science. The determination of differences of longitude by electro-magnetic signals gave a new importance to the assumed value of the velocity of electricity, which did not escape his practical mind. His mechanical skill enabled him to apply his ideas rapidly to practice, and his great independence and energy of character surmounted pecuniary restrictions which would have fatally discouraged most men. In 1836 and 1837 Mr. Mitchel was Chief Engineer of the Little Miami Railroad, and in 1848 of the Ohio and Mississippi Railroad. In 1841 he was placed upon the Board of Visitors for West Point, and in 1847 – 8 he was Adjutant-General of the State of Ohio. He was chosen Director of the Dudley Observatory at Albany in 1859.

As soon as the rebellion broke out, Mr. Mitchel promptly resigned the peaceful pursuits of science, in which he had achieved large honor and usefulness, and gave himself, with all the ardor of his nature, to the cause of his country. On the 9th of August, 1861, he was commissioned a Brigadier-General of Volunteers, and on the 11th of April, 1862, as Major-General in the Department of the Ohio under General Buell. At the head of an independent column, he entered Bowling Green, Kentucky, in close pursuit of the retreating rebels, and, continuing his advance southward, he seized the line of railroad between Corinth and Chattanooga, and established his forces in the north of Alabama. He was relieved of that command in July, 1862, and on the 17th of September he assumed the charge of the Department of the South. He had barely time to give promise of inaugurating a vigorous campaign, when he was seized with yellow-fever, and, after a brief illness of four days, he died at Beaufort, South Carolina, on the 30th of October, 1862, leaving to the world the memory of a name which deserves well of science and of his country.

James Renwick, our late Associate in the section of Technology and Engineering, was descended from a Scotch family, his grandfather having emigrated to the United States from Scotland. His father, William Renwick, was a merchant of New York, who married a lady of Scotland during a visit to that country. Professor Renwick was born at Liverpool in 1702, and came to this country with his parents when he was two years old. He exhibited very early in life a devotion to books, and a remarkable capacity and power for acquiring knowledge.

This is fully shown by the fact that he was sufficiently advanced to enter Columbia College at the age of eleven years, and he was graduated, at the head of a class of twenty-two, at the age of fifteen years. At the age of twenty-one, he was appointed provisionally to the chair of Chemistry. Shortly after this he became a trustee, and in 1820, at the age of twenty-eight, he was appointed to the Professorship of Natural and Experimental Philosophy and Chemistry, a chair which he filled for the long period of thirty-three years. During this time his lectures embraced Natural and Experimental Philosophy, Chemistry, Geology, Mineralogy, Practical Mechanics, and for a long period Astronomy; and he was able, by his unfaltering industry and great memory, to master and communicate to his classes a knowledge of the most important discoveries made through these vast fields of science. In the year 1838 he was appointed one of the Commissioners for the survey of the Northeastern Boundary, and his letters to a distinguished friend in England are said to have had much influence in preparing for the subsequent diplomatic arrangement upon that subject. As a writer, Professor Renwick is known by several treatises on Chemistry and Mechanics. He likewise wrote somewhat elaborate biographies of Fulton, Rittenhouse, and DeWitt Clinton, not to mention large contributions to various reviews and scientific journals. To this array of Professor Renwick's wide acquirements and labors we must not omit to add, that his taste for the fine arts was highly cultivated, and his critical knowledge, especially of painting, often referred to as exact and authoritative.

Although Professor Renwick made no great discovery by which the boundaries of science were enlarged or the mastery of man over nature increased, yet the influence exercised by his full mind upon a very large and active community was extensively felt, and tended greatly to the advancement of knowledge and the arts. He died at his residence in New York, after a short illness, on the 12th of January, having nearly completed his seventy-first year.

Charles Wilkins Short, M. D., one of the pioneers of Botany in the Western States, died at his residence near Louisville, Kentucky, on the 7th of March last, in the sixty-ninth year of his age. He was born in Woodford County of that State, in October, 1794, took his medical degree from the University of Pennsylvania in the year 1815, was called to the chair of Materia Medica and Botany in Transylvania University in 1825, and to the same chair in the new University at

Louisville in 1838, fulfilling his duties as Professor with assiduity and success until the year 1849, when he retired from public functions. He was for many years one of the conductors of the Transylvania Journal of Medicine, to which he contributed numerous scientific papers, mostly relating to the botany of his native State. Dr. Short's influence upon the advancement of the science to which he devoted himself was more considerable than would be inferred from the extent of his publications. He was a keen observer, a diligent explorer, a liberal promoter of the explorations of others, and a bountiful correspondent. There are few herbaria of consequence in this country or in Europe that have not been enriched by choice contributions from his hands. He and the late Mr. Oakes, independently, and at nearly the same period, seem to have invented the art of preserving perennially in dried specimens almost all the beauty and attractiveness, and the scientific usefulness, of the living originals. The frequent recurrence of his name in the pages of the systematic botanical works of the last thirty years testifies to his scientific industry. His faults were an unwarrantable diffidence, a too fastidious taste, and the total absence of personal ambition, together conspiring to limit unduly his endeavors in the fields of original investigation and authorship.

Edward Robinson, our late eminent Associate in the section of Philology and Archæology, belongs to that not inconsiderable class of men who are led into a literary career by their decided taste, by their inner prompting, and in spite of outward impediments. Born on the 10th of April, 1794, in Southington, Connecticut, where his father was settled as a parish minister, he attended first the common school of his native town, and then a private school, kept by a clergyman. In his sixteenth year he was apprenticed to a merchant; but a year later, after many fruitless efforts, he overcame the opposition of his father, and obtained permission to enter Hamilton College, in the State of New York. Here he pursued his studies, chiefly under the guidance of his maternal uncle, one of the Professors, and graduated in 1816. He now entered the office of a lawyer in Hudson; but within a year he accepted an appointment as a Tutor in Hamilton College, where he taught Mathematics and Greek. In 1818 he married the daughter of the well-known missionary to the Indians, Samuel Kirkland. She died within the year. He remained in charge of the farm belonging to her, and devoting himself also to classical studies, until 1821, when he went to Andover, where, without becoming a regular

member of the Seminary, he studied theology, and became in 1823 one of the teachers of the institution. He translated at that time Wahl's *Clavis Novi Testamenti*, and, in connection with Professor Stuart, Winer's Grammar of the Language of the New Testament.

Full of admiration of thorough German scholarship, he determined to pursue his studies in Europe, whither he went in 1826, and devoted himself, first at Paris, but chiefly at Halle and Berlin, to Biblical and Oriental studies. At Halle he married the youngest daughter of Professor Von Jacob, a lady known to the public by her *nom de plume* of Talvi. After a residence of four years, which was of incalculable influence upon his succeeding career, and after extensive travels in Europe, he returned in 1830 to this country, and was immediately made Assistant Professor and Librarian at the Theological Seminary at Andover. While yet in Germany, he had translated the large Greek Grammar of Buttmann, which was published immediately after his return. He was one of the founders of the Biblical Repository, and for several years a principal contributor to its pages. In 1833 the state of his health induced him to resign his office at Andover, and remove to Boston. Here he was particularly occupied with the preparation of a new Greek-English Dictionary of the New Testament, and a translation of Gesenius's Hebrew-Latin Lexicon. Both were published in 1836. In the following year he accepted the professorship of Biblical Literature in the newly-established Theological Seminary in the city of New York, on condition of being permitted to visit Europe once more. Revisiting Germany, he now, according to a plan cherished and matured for fifteen years, with the late Dr. Eli Smith, the well-known missionary at Beirût, made a journey to Egypt and Palestine. Returning from his travels in the autumn of 1838, he took up his residence in Berlin, where he remained until August, 1840, to elaborate the results of his researches in his celebrated work, entitled "Biblical Researches in Palestine and Adjacent Countries," which appeared simultaneously in Germany and England. Of this work, Karl Ritter said: "It will occupy one of the most important places for the study of geographico-antiquarian sources of the Scriptures: it will, on account of the many new discoveries and investigations it records, be of enduring value for our knowledge of the Orient, and will furnish the data for an entire reconstruction of the cartography of Palestine, hitherto so imperfect."

Returning now to America, he commenced his official labors in the

Union Theological Seminary in New York, and continued them until 1852, when he undertook a second visit to Palestine, for the purpose of re-examining many points discussed in his work. It was his intention to give the results of these extensive, patient, and thorough researches in a work entitled "A Physical and Historical Geography of the Holy Land." A few years ago, his literary labors were seriously interrupted by the formation of a cataract; and as his health as well as his sight had suffered in consequence of an unsuccessful operation, he last summer sought medical advice in Europe, from which he returned in October last. He died in New York, in January, in the sixty-ninth year of his age.

Dr. Robinson's residence at a distance from Boston prevented him from taking that active part in the doings of this Academy which he undoubtedly would have done had he lived among us. Different was his relation to another association, the Oriental Society, of which he was one of the original members, and, after the death of the lamented Mr. Pickering, its President. That Society enjoyed the great advantage of being represented by one whose position in the republic of scholars all over the world was recognized and appreciated; and it will be no easy task for any one to fill as honorably and successfully the place occupied by him for seventeen years.

After this brief sketch of Dr. Robinson's labors, it is unnecessary to speak of his character as a scholar. His works speak for him. If any one characteristic were to be mentioned as pre-eminent, it would be that of thoroughness, — thoroughness in investigating, thoroughness in considering and maturing, thoroughness in elaborating the subjects of his choice. This quality was conspicuously shown in the manner in which he prepared himself for his first visit to Palestine. He understood the whole ground, — he made himself familiar with all that had been written and done up to that time, — he consulted every scholar in this country and Europe from whom he could expect to receive useful hints. And, not satisfied with his first explorations, large and valuable as they were, his irresistible desire of exhausting, if possible, his subject, led him to undertake a second visit. The same quality of thoroughness was illustrated in another way. Although to him the knowledge of the German language was merely a means to the end, — an instrument, — it would be very difficult to find an American or Englishman who had mastered that language so thoroughly, and entered so deeply into its spirit and essence.

Sir Benjamin Collins Brodie, Bart., a Foreign Honorary Member of this Academy, and recently President of the Royal Society, died, October 21st, 1862, at the ripe age of eighty years. Of that remarkable trio of British surgeons of this century, distinguished alike for their high professional and scientific attainments, Sir Astley Cooper, Sir Benjamin Brodie, and Mr. William Lawrence, the latter now alone remains. Sir Benjamin Brodie was born at Winterslow, Wiltshire, June 9th, 1783. He commenced the study of medicine in London, under the distinguished anatomists Wilson and Thomas, at the Hunterian School of Anatomy, in Great Windmill Street, and subsequently became the pupil of Sir Everard Home, and at a later period his assistant. His first scientific paper was a communication made to the Royal Society, through Sir Everard Home, in 1809, the year before his election as a Fellow of the Society. During the next five years he published in the Philosophical Transactions a series of papers giving the results of experimental researches upon the agency of the brain in maintaining the heart's action, in the processes of secretion, and in the production of animal heat; upon the mode of action of poisons on the animal economy; and upon the influence exerted by the pneumo-gastric nerve over the secretions of the alimentary canal. These papers gained for him European fame as a physiologist. But great as was his success in this department of science, he yielded to the increasing demands of practice, and devoted his whole energies to his chosen pursuit of surgery. He nevertheless always retained a deep interest in the subjects of these early investigations, and after his retirement from active practice he collected his Physiological Essays in a volume, which he republished in the year 1851, with corrections and additions.

His first and most important contribution to surgery is his classical "Observations on the Diseases of the Joints," the first outlines of which appeared in the Medico-Chirurgical Transactions for 1813 and the two subsequent years, and of which five editions were published, the last revised, and in part rewritten, in the year 1850. When he undertook this work, the whole subject was involved in the greatest confusion, and the terms "white-swelling," "scrofulous joints," &c. "were used without any well-defined meaning, and almost indiscriminately, so that the same name was frequently applied to different diseases, and the same disease distinguished by different appellations." This confusion he unravelled, and first established the indications of treatment upon the firm basis of accurate diagnosis.

His next surgical work was a course of "Lectures on the Diseases of the Urinary Organs," published in the year 1832; it has gone through four editions, and is still one of the standard works on that subject. In these lectures he considered the operation of lithotrity, which had been performed for the first time upon the living subject by the distinguished Civiale eight years before, and which had been brought to perfection by the improved instruments of Ammusat and Heurteloup. The novel idea of crushing the stone in the bladder, as a substitute for its extraction by a cutting operation, encountered bitter opposition from many of the leading surgeons of the day, who had acquired great dexterity in the performance of lithotomy, and therefore regarded with distrust the new method, which threatened to supersede it. Brodie treated the subject in the spirit of a philosopher, and gave it as his opinion that lithotrity might ultimately take the place of the older operation; and he lived, not only to see it used by others, but to employ it himself with perfect success. In fact, with the exception of a few special cases, as in young children, in whom lithotomy is an operation of comparatively little danger, and in cases of very large or very hard calculi, and perhaps in a few other instances, lithotrity is now the regular method.

A third surgical work, published in 1837, is devoted to the study of certain painful affections, principally of the joints, which occur, for the most part, in women, and in those who are more or less under the influence of the nervous system. In these "Hysterical Affections of the Joints," he showed that there is little or no local disease, and that the violent and protracted local treatment formerly in vogue, and which often ended in amputation, ought to be altogether abandoned, and the disease treated by constitutional remedies of a tonic and invigorating character.

Sir Benjamin's last work, and that by which he is best known to literary and scientific men in general, is his "Psychological Inquiries, being a Series of Essays intended to illustrate some Points in the Physical and Moral Nature of Man." In this charming work he lays open, in the familiar form of dialogue, the operations of his own vigorous intellect, and displays that rare combination of sound judgment with the highest powers of observation which constitutes the true philosopher. Writing less than many others, he wrote more; for every sentence is pregnant with meaning, and every well-established premise leads to the wisely-drawn conclusion.

Sir Benjamin Brodie has been Professor of Anatomy and Surgery to the Royal College of Surgeons, and was at one period of his life Surgeon to St. George's Hospital. He was Surgeon to King George IV., and Sergeant-Surgeon to King William IV., in whose reign he was created a baronet. He was afterwards Surgeon to H. R. H. Prince Albert, and Sergeant-Surgeon to her present Majesty Queen Victoria.

The actual list of the Academy, as recently revised, will be found appended to the new half-volume of the Memoirs, which now lies upon the table. It will be seen that there are at the present time 164 Resident Fellows, 82 Associate Fellows, and 72 Foreign Honorary Members.

In conclusion, the Council presented to the Academy certain nominations.

The Treasurer read his annual report, which was accepted and ordered to be entered on the records.

Professor Lovering, the Chairman, read the report of the Committee of Publication, which was accepted and ordered to be placed on file.

Dr. Beck offered two resolutions, proposing to request the American Minister in Italy to use his influence, on the earliest opportunity, in furtherance of such changes in the administration of the Vatican Library as will enable students to consult it. With the assent of the mover, the resolutions were referred to the Council.

The annual election took place, and the following officers were chosen for the ensuing year: —

Asa Gray, *President.*

Charles Beck, *Vice-President.*

William B. Rogers, *Corresponding Secretary.*

Chauncey Wright, *Recording Secretary.*

Edward Wigglesworth, *Treasurer.*

Josiah P. Cooke, *Librarian.*

Council.

THOMAS HILL,
GEORGE P. BOND, } of Class I.
JOHN B. HENCK,

AUGUSTUS A. GOULD,
LOUIS AGASSIZ, } of Class II.
JEFFRIES WYMAN,

ROBERT C. WINTHROP,
GEORGE E. ELLIS, } of Class III.
HENRY W. TORREY,

Rumford Committee.

JOSEPH LOVERING, JOSEPH WINLOCK,
MORRILL WYMAN, CHARLES W. ELIOT,
WILLIAM B. ROGERS, THEOPHILUS PARSONS,
CYRUS M. WARREN.

Committee of Finance.

ASA GRAY,
EDWARD WIGGLESWORTH, } *ex officio*, by statute.
J. INGERSOLL BOWDITCH, by election.

The other Standing Committees, appointed on nomination from the chair, are as follows: —

Committee of Publication.

JOSEPH LOVERING, JEFFRIES WYMAN,
CHARLES BECK.

Committee on the Library.

AUGUSTUS A. GOULD, WILLIAM P. DEXTER,
JOHN B. HENCK.

Committee to audit the Treasurer's Accounts.

THOMAS T. BOUVÉ, CHARLES E. WARE.

Mr. Safford presented the following paper: —

On the Observed Motions of the Companion of Sirius. By T. H. SAFFORD, *Assistant at the Observatory of Harvard College.*

It is well known to astronomers that the motions of the bright star Sirius indicated the presence of a disturbing body, before the discovery of a companion by Mr. Alvan Clark. It was shown by Bessel,* that there were irregularities in the motion of this star in right ascension which were only to be explained by the presence of an unseen companion, unless, indeed, we might permit ourselves to doubt the universality of the law of gravitation. C. A. F. Peters,† some years later, computed such of the elements of the motion of Sirius around the centre of gravity of the system as could be deduced from the motions in right ascension; and Schubert‡ pointed out that there was some reason to believe that the motion in declination also was irregular, though he seems to have fallen into the error of supposing that the motions in right ascension and declination were not completed in the same period.

Afterwards M. Laugier,§ of the French Institute, represented the observations of Sirius in declination from 1690 to 1852 by a formula of interpolation which I fear we must consider erroneous. Laugier gives a certain weight to Flamsteed's position from the *Historia Cœlestis Britannica*, which is known to have been reduced (and probably from a single observation), without regard to aberration or nutation; so that it cannot be depended upon within 15″, while the real irregularities of Sirius's motion in declination are less than 2″.

Calandrelli,¶ Director of the Pontifical Observatory** at Rome, has in several places insisted that the Greenwich Twelve-Year Catalogue was in error by about 3″ for the date 1845. This, however, was shown by Main†† to be contradicted by the several years' work; and I pre-

* Astronomische Nachrichten, Nos. 514, 515, 516.

† Ibid., Nos. 745, 746, 747.

‡ Astronomical Journal, Vol. I. p. 154.

§ Astronomische Nachrichten, No. 1142.

¶ Atti dell' Accademia Pontificia de' Nuovi Lincei, 5 Aprile, 1853, p. 316, and elsewhere.

** This is not to be confounded with the observatory of the Collegio Romano.

†† Monthly Notices of the Royal Astronomical Society, Vol. XX. p. 202.

sume most astronomers would agree in considering Calandrelli's argument as irrelevant.

In No. 28 of Professor Brünnow's valuable "Astronomical Notices" I have shown that, in spite of the misapprehensions to which I have just alluded, the observed motion of Sirius in declination is in fact represented by a formula depending on the previous investigation of Peters, but with four new unknown quantities inserted. The addition of these four quantities, which I have determined by least squares, enables us to state with a certain degree of accuracy the angle of position of the centre of gravity with respect to the visible mass, and thus the angle of position of the supposed invisible companion.

Closely following the actual publication * of this memoir, came the discovery † of the companion by Mr. Clark. The question at once arose, whether this were the disturbing body; the evidence bearing upon this appeared very noteworthy. In the first place, the angle of position agreed (within the uncertainty of observation) with that computed for the disturbing body, assuming my investigation ‡ as the basis. The following table shows the relation for 1862 between computation and observation. To my own computation I have added the similar one of Auwers, published afterwards. §

Computed by	Auwers,	1862.1	97.°3
"	Safford,	1862.1	83.8 (yearly diminution 1.°4)
Observed by	Bond, ‖	1862.2	84.6
"	Chacornac, ¶	1862.2	84.6
"	Lassell, **	1862.3	83.8
"	Rutherfurd, ††	1862.2	85.0

The difference between Dr. Auwers's theoretical investigation and my own is perhaps not larger than the uncertainty of all the series of observations on Sirius would explain; as I have before stated, the

* The number bears date, Dec. 20, 1861; my own communication, Sept. 20th.

† Jan. 31, 1862. First announced by Professor Bond, in No. 1353 of the Astronomische Nachrichten.

‡ This fact was stated by Professor Bond (American Journal of Science for March, 1862, p. 287).

§ Astronomische Nachrichten, No. 1371. It is proper for me here to express my sense of the courtesy with which Dr. Auwers admitted my priority in the matter

‖ Astronomische Nachrichten, No. 1374.

¶ Ibid., No. 1355.

** Ibid., No. 1360.

†† American Journal of Science, May, 1863, p. 407.

amount of deviation from which the angle of position was computed is very small.

But that the companion of Sirius may produce the disturbances, it, the faint object barely visible in the largest class of telescopes, must have a mass nearly *two thirds* that of Sirius itself. It is difficult to believe this; but, as the evidence of this year (1863) shows, we may be compelled to do so.

There are three hypotheses logically possible with respect to the new star. It may be either unconnected with the system of Sirius, or, secondly, a satellite but not the disturbing body, or, thirdly, the disturbing body itself. On the first hypothesis, the proper motion of Sirius itself would put it in the following position, assuming the angle of position 84°.5, for 1862.2, and distance 10″.19 for the same date, the latter being the mean of these results (excluding Lassell's 4″.92, which is quite wrong).

10″.09	Rutherfurd,*
10.07	Bond.†
10.41	Chacornac.‡

Position and Distance by Hypothesis I.; assuming the little star to be fixed.

1863.0	79°.1	10″.80
1864.0	73.3	11.69

The second hypothesis gives no ground for calculation, and it will be considered further on.

The third hypothesis would give (correcting my own investigation, so as to agree in 1862.2 with observation, by + 0°.9).

1863.0	83°.5
1864.0	82.1

Observation gives, compared with these hypotheses,

1863.3	Bond,§	82°.8	Hyp. I.	77°.4	Hyp. III.	83°.1
1863.2	Rutherfurd,‖	81.2		77.9		83.2

	Computed — Observed.	
	I.	III.
Bond,	— 5°.4	+ 0°.3
Rutherfurd,	— 3.3	+ 2.0

* American Journal of Science for May, 1863, p. 407.

† Astronomische Nachrichten, No. 1374.

‡ Ibid., No. 1355.

§ MS. furnished by Professor Bond.

‖ As before, American Journal of Science for May, 1863, p. 407.

To which must be added, that the first hypothesis requires an increase of distance between 1862.2 and 1863.2 of 0″.8 ; the third, a very slight diminution ; but observation indicates a diminution of about 0″.55, a quantity, to use Mr. Rutherfurd's expression,* "so small that its existence cannot be asserted with confidence." It is hardly conceivable that the long and careful series of observations of Mr. Rutherfurd should be in error 3°.3 ; and also inconceivable that Professor Bond's measures, agreeing as they do within 2° 20′ among themselves, should be in the mean 5°.4 erroneous.

We have, therefore, nothing to oppose to the hypothesis that the new companion is the disturbing body, but the very improbable supposition that the small star partakes very nearly in the great proper motion of Sirius without physical connection ; or the second hypothesis, that the new star is in the system, but with small mass. If this is the case, the disturbing body must, in lieu of the small light of the companion, have still less, or even be absolutely invisible. *It is consequently highly probable that the disturbing body has been actually found ; that what was predicted by theory has been confirmed by sight.* The importance of continued observations on Sirius cannot be too highly felt. The companion must be measured the coming year, and for several years ; while Sirius itself should be re-observed with meridian instruments. So far as the right-ascension element is concerned, a series of observations is now in progress at Cambridge ; while Captain Gilliss has most obligingly consented to make a series of declination-observations at Washington ; and the standard observatories at Greenwich and Paris will doubtless continue their series of fundamental star observations, including, of course, Sirius.

I am much obliged to Mr. Rutherfurd for the communication of the details of his observations in 1863, and hope he will publish them, together with similar details of those of 1862, and others to be made hereafter. The subject is one where the co-operation of several observers is desirable. Full certainty here can only be obtained after several years' observations.

On motion of the Corresponding Secretary, the meeting was adjourned to Tuesday, the 9th of June.

* As before, American Journal of Science for May, 1863, p. 407.